Matching Through Search Channels

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Motivation

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- Worker reallocation is a pervasive phenomenon of labour markets.
- Reallocation is hampered by frictions: matching is a time-consuming and costly process due to search and screening activities.
- To deal with these frictions firms and workers use different ways of contacting each other:
  - Job postings - can reach more applicants
  - Personal/employment networks - aim to reduce screening costs
  - Public agencies - state funded search to get unemployed back to work
  - ...
- We know very little about how the choices of these *search channels* impact labour market turnover and the allocation of heterogeneous workers into heterogeneous jobs.

What do we do

Questions

- How do heterogeneous workers and firms make use of different search channels?
- How do search channels impact sorting and productivity?

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Empirics

- Use unique German firm and worker survey data linked with administrative employment records.
- New evidence on how search channels and matching outcomes vary across workers and firms.

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Theory

- Incorporate multiple search channels in an equilibrium labour market model with on-the-job search and two sided heterogeneity.
- Structural estimation:
  - Evaluate the impact of channels on sorting.
  - Role of the public employment agency.

Literature

Search intensity of workers and firms
e.g. Holzer (1988), Shimer (2004), Krueger & Mueller (2010, 2011), Mukoyama, et al. (2018), Faberman et al. (2021), Carrillo-Tudela, et al. (2021), Lochner et al. (2020), Mueller et al. (2021).

Personal networks and referrals
e.g. Ioannides & Louri (2004), Capellari & Tatsiramos (2015), Brown, et al. (2016), Galenianos (2014, 2021), Dustmann et al. (2016), Lester, et al. (2022).

Labor market sorting
e.g. Abowd, et al. (1999), Gautier and Teulings (2006), Eeckhout and Kircher (2011), Card, et al. (2013), Hagedorn, et al. (2017), Lopes de Melo (2018).

Equilibrium job ladder models
e.g. Burdett & Mortensen (1998), Postel-Vinay & Robin (2002), Cahuc, et al. (2006), Bagger and Lentz (2019), Burdett, et al. (2016, 2020).

Data

Administrative Data

Several data sources of Germany's Institute for Employment Research (IAB).

- Integrated Employment Biographies (**IEB**): Administrative records of employment spells of private-sector workers, including
  - education, age, gender, nationality, occupation, industry
  - full/part time, daily earnings (top-coded)

- We link the IEB to worker and firm surveys maintained by the IAB.

Survey Data

- Job Vacancy Survey (**JVS**): Annual representative **establishment survey** with detailed recruitment information about the last case of a hire
  - $\approx$ 10,000 observations per year
  - Use of search channels, successful channel, further recruitment information.
  - Can be linked to the IEB data (through establishment ID) since 2010.
  - Using the algorithm developed by Lochner (2019) hired worker can be identified in IEB data in $\approx$ 70% of cases.

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  - Using the algorithm developed by Lochner (2019) hired worker can be identified in IEB data in $\approx$ 70% of cases.

- Panel Study Labour Market and Social Security (**PASS**): Annual representative **worker survey**
  - $\approx$ 8,000 observations per year.
  - Job search strategies (e.g. use of search channels) of employed and non-employed workers.
  - Retrospective information about successful channel.
  - Can be linked to IEB data (through worker ID) since 2006.

Use and Success of Search Channels

- Firms use on average 2 channels and workers use on average 2.3 channels.

	Firms (JVS)		Workers (PASS)	
Search channel	Use (%)	Successful (%)	Use (%)	Successful (%)
Postings	58.9	33.7		
Networks	46.5	31.9		
Public Agency	39.5	12.2		
Unsolicited	24.9	10.6		
Internal	23.3	7.0		
Private Agent	7.5	3.2		
Others	2.3	1.3		
Total	**202.8**	**100.0**		

- Posting, Networks and the Public Employment Agency are the main channels used by workers and firms.
- Higher success rate through Posting and Networks.

Use and Success of Search Channels

- Firms use on average 2 channels and workers use on average 2.3 channels.

	Firms (JVS)		Workers (PASS)	
Search channel	Use (%)	Successful (%)	Use (%)	Successful (%)
Postings	58.9	33.7	88.1	23.9
Networks	46.5	31.9	60.22	31.1
Public Agency	39.5	12.2	57.3	16.3
Unsolicited	24.9	10.6	-	-
Internal	23.3	7.0	-	-
Private Agent	7.5	3.2	12.1	3.3
Others	2.3	1.3	16.9	25.5
Total	**202.8**	**100.0**	**234.6**	**100.0**

- Posting, Networks and the Public Employment Agency are the main channels used by workers and firms.
- Higher success rate through Posting and Networks.

Ranking Firms and Workers

- Estimate AKM model following Card et al. (2013)

$$y_{it} = \alpha_i + \gamma_{J(i,t)} + \beta X_{it} + u_{it} \ ,$$

with
- y_{it} log real daily wage of worker i in year t
- α_i worker fixed effect
- γ_j firm fixed effect
- X_{it} cubic in age interacted with education and year dummies

- Workers between the ages of 20-60 years.
- Compute fixed effects using two different periods: (i) 2003–2010 and (ii) 2010–2016.
- We then attribute these fixed effects to the JVS sample and the PASS sample, respectively.

Empirical Patterns

Conditional correlations: fixed effects and search channels

Firms (JVS matched IEB)

- We consider a set of regression models

$$SC_{j,t} = \beta_0 + \beta_1 \gamma_j + \beta X_{j,t} + \epsilon_{j,t},$$

  where $SC_{j,t}$ is the outcome variable, γ_j denotes the AKM firm fixed effect and X additional controls like job requirements, firm age (quad), 6 firm size categories, one-digit industry, and financial, demand and workforce constraints.

- We also control for the hired work AKM fixed effect and interactions between the fixed effects and the search channels.

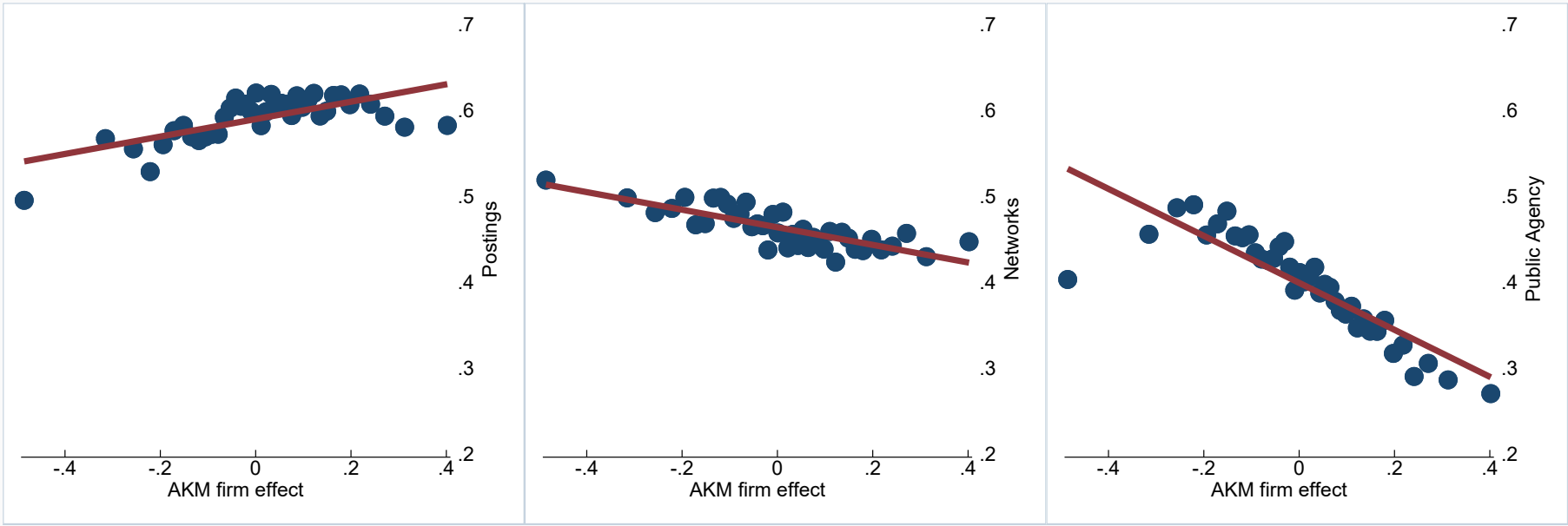
Workers (PASS matched IEB)

- We consider a set of regression models

$$SC_{i,t} = \beta_0 + \beta_1 \alpha_i + \beta X_{i,t} + \epsilon_{i,t},$$

  where $SC_{i,t}$ is the outcome variable, α_i denotes the AKM worker fixed effect and X additional controls like quadratic on age, employment status and one-digit occupation dummies.

Firms: Probability of using a search channel (LPM)

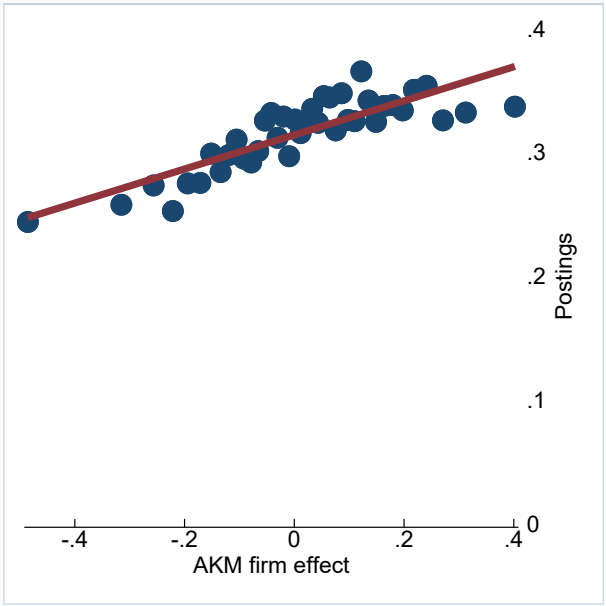


(a) Postings: 0.021*** **(b)** Networks: -0.022*** **(c)** Public Agency: -0.056***

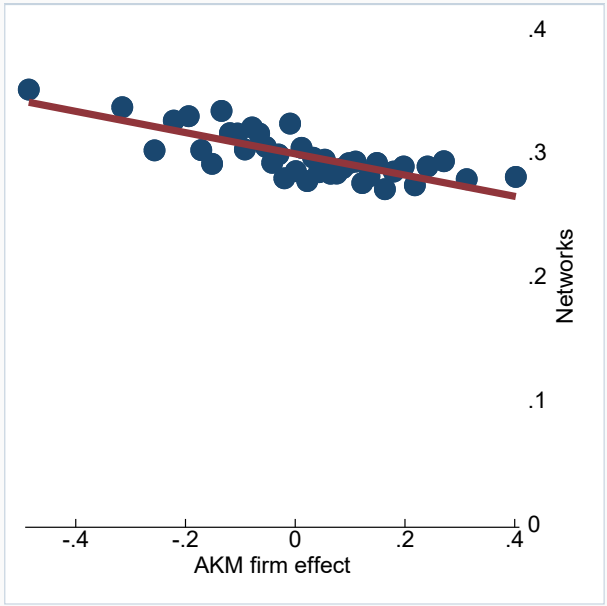
Controls: Job requirements, firm age (quad), 6 firm size categories, one-digit industry, and financial, demand and workforce constraints.

▸ Further variables

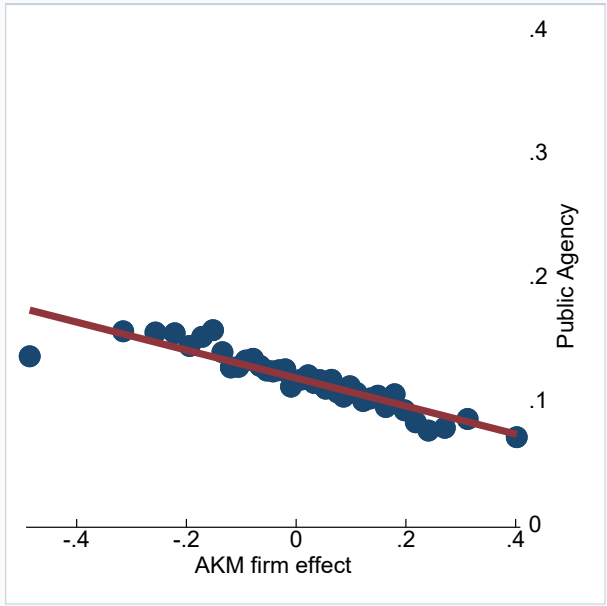
Firms: Probability of hiring through a search channel (LPM)



(d) Postings: 0.029***



(e) Networks: -0.021***

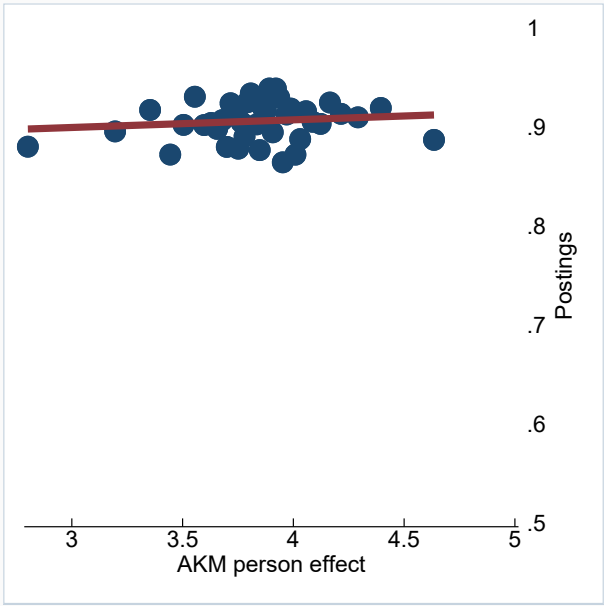


(f) Public Agency: -0.026***

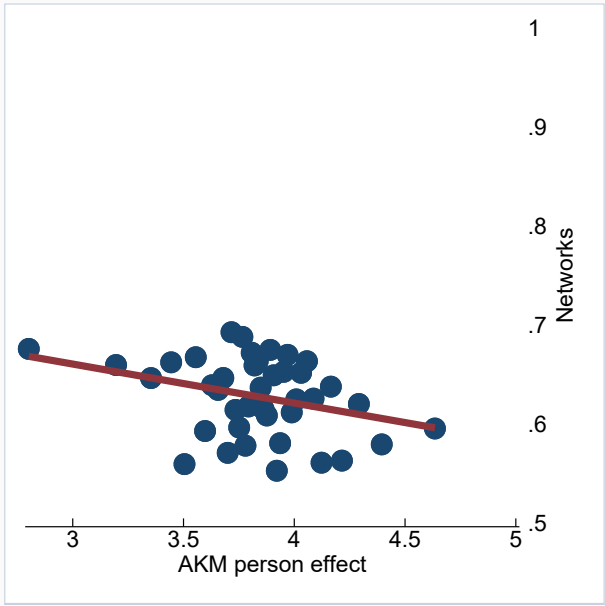
Controls: Job requirements, firm age (quad), 6 firm size categories, one-digit industry, and financial, demand and workforce constraints.

▸ Poaching index

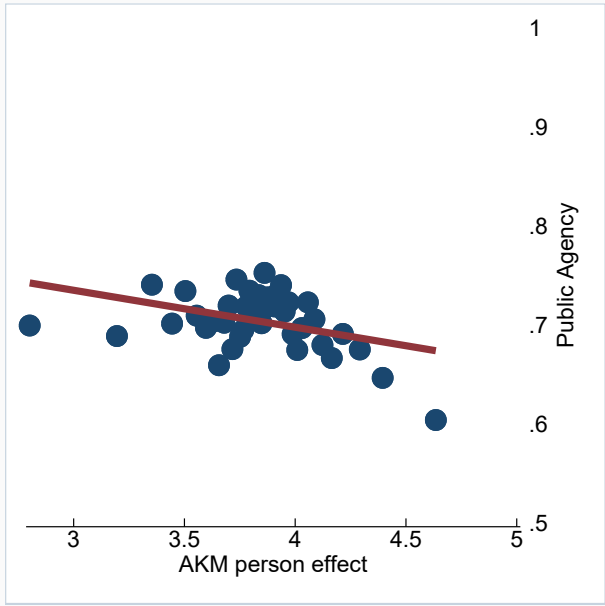
Workers: Probability of using a search channel (LPM)



(g) Postings: 0.003



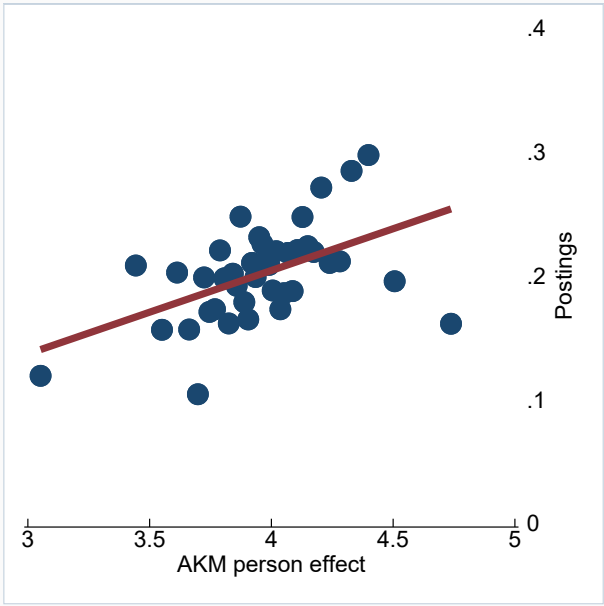
(h) Networks: -0.014**



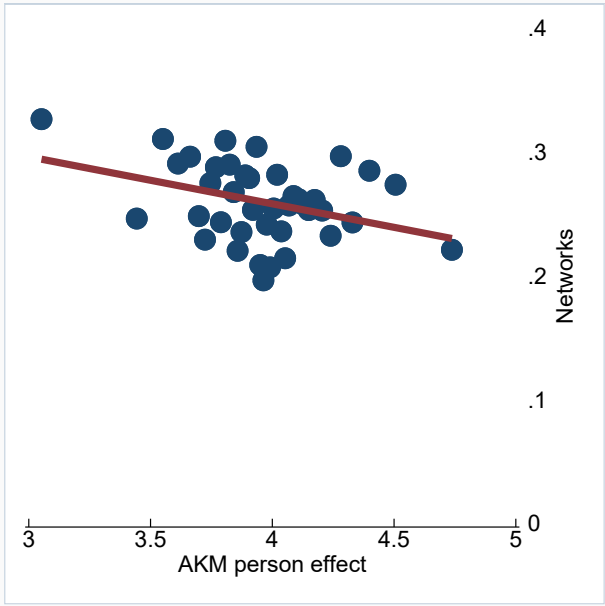
(i) Public Agency: -0.013***

Controls: Education, age (quad), gender, previous employment status, one-digit occupation.

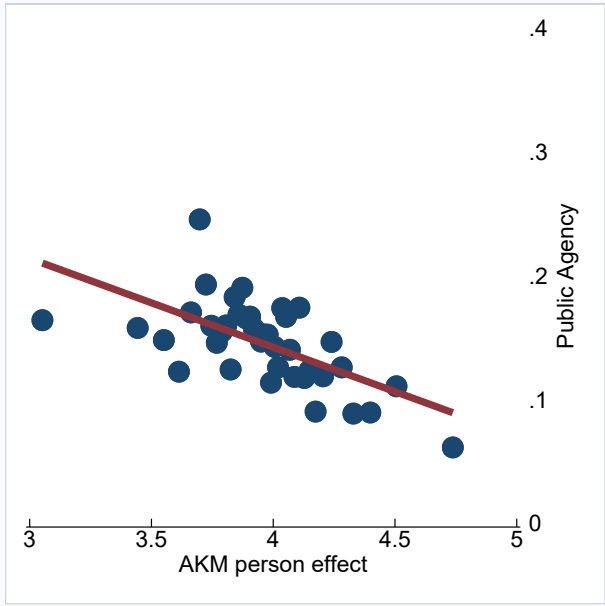
Workers: Probability of being hired through a search channel (LPM)



(j) Postings: 0.024***



(k) Networks: -0.014**



(l) Public Agency: -0.026***

Controls: Education, age (quad), gender, previous employment status, one-digit occupation.

Key findings I:

Firms

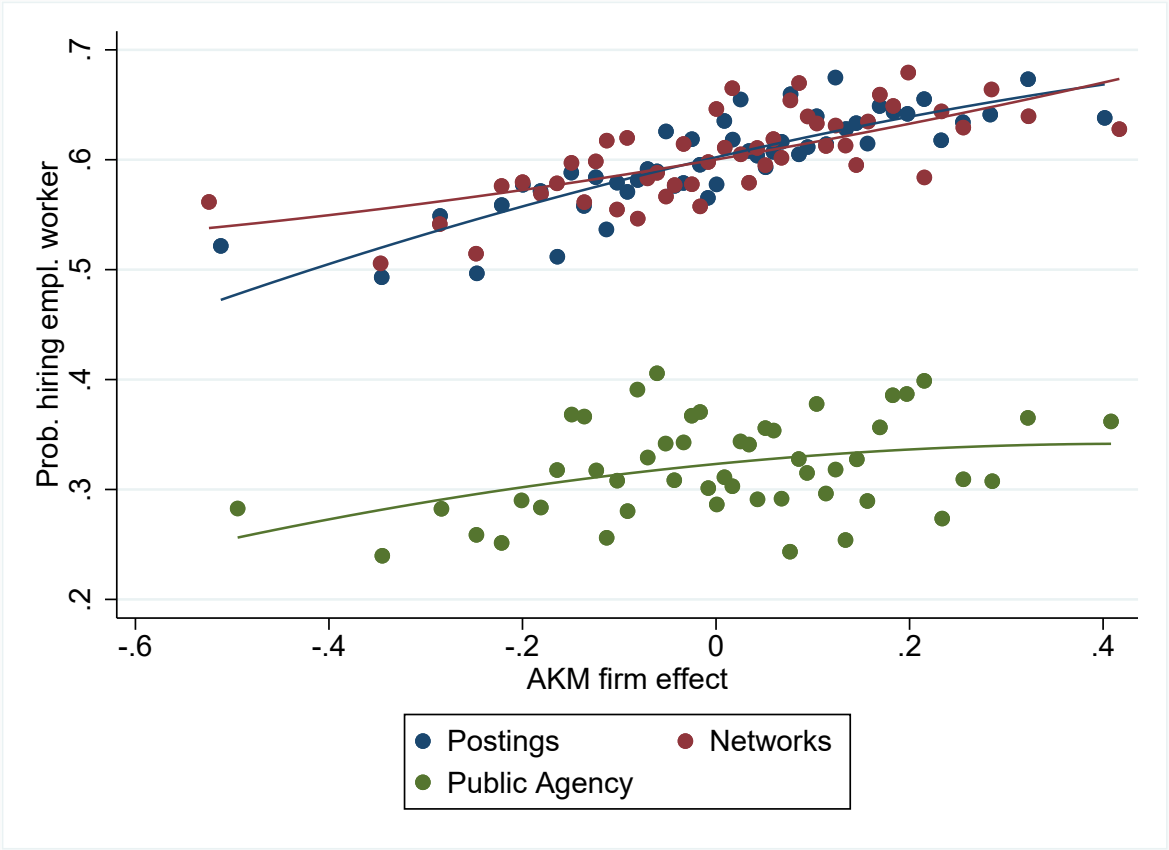
1. High-wage firms make more use of job postings and hire more through this channel.
2. Low-wage firms make more use and succeed to hire more often through personal networks or the public employment agency.

Workers

3. High-wage workers use job postings and find jobs more via postings more frequently.
4. Low-wage workers are more likely to use and succeed finding jobs via networks and the public employment agency.

Search Channels and Poaching (JVS-IEB)

Probability of hiring an employed worker by firm rank



- Lower ranked firms that use networks have a higher probability of poaching a worker than similar firms that use posting.
- Hiring though the PEA leads to the lowest probability of poaching a worker.

▸ Table

Search Channels and the Job Ladder (JVS-IEB)

Change in firm effect at an *EE* transition by search channel

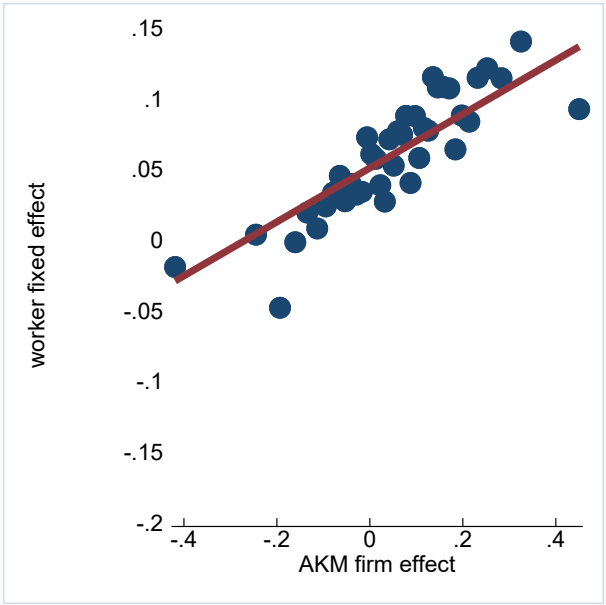
	(1) △ firm effect	(2) △ firm effect
	w/o controls	worker controls
Reference=Posting		
Networks	-0.0293***	-0.0305***
	(0.0047)	(0.0050)
Public Agency	-0.0189**	-0.0305***
	(0.0077)	(0.0083)
Constant	0.0585***	0.3098***
	(0.0032)	(0.0448)
mean △ firm effect	0.0440	0.0468
st.d. △ firm effect	0.2555	0.2506
Observations	13,283	11,137
Adjusted R^2	0.0028	0.0217

Worker controls: change in occupation, change in hours, educational attainment (category), AKM person effect.

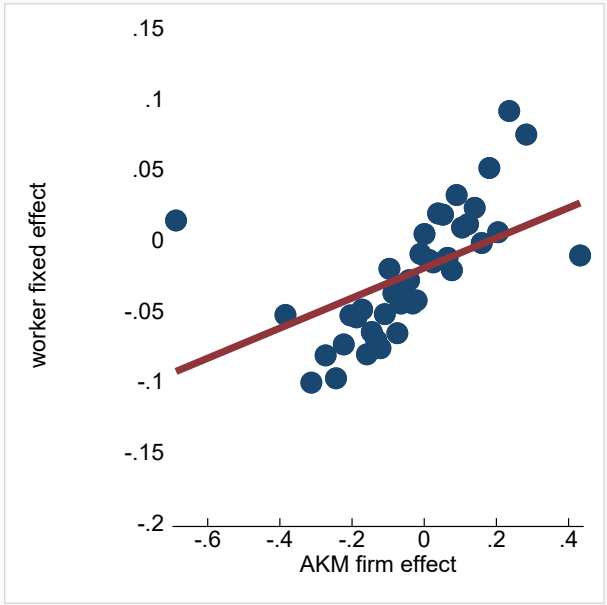
- On average workers climb the firm rank through *EE* transitions.
- Workers climb faster using posting relative to networks and PEA.

Search Channels and Type of Hired Worker (JVS-IEB)

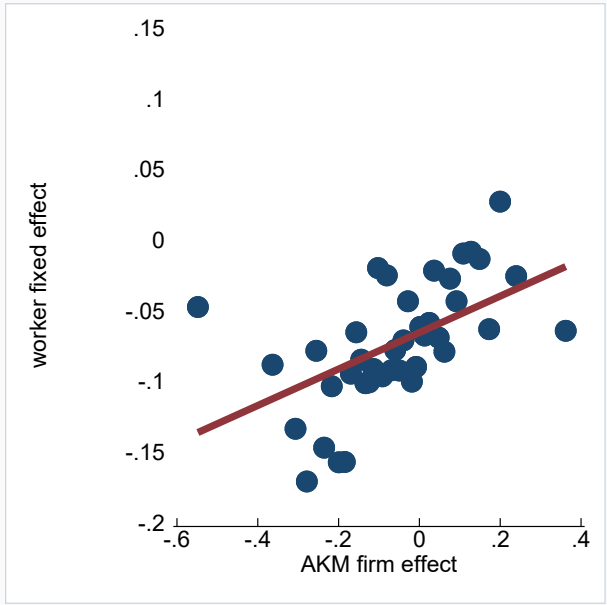
Relation between worker and firm rank by search channel



(m) Postings



(n) Networks



(o) Public Agency

Hiring through posting:

- allows firms to hire higher ranked workers
- steeper increase between hired worker and the hiring firm.

▸ Table ▸ Match Stability

Key findings II:

Worker and Firm Match

5. Job postings help to poach and attract high-wage workers, especially for high-wage firms.

6. Networks help to poach high-wage workers, in particular for low-wage firms.

7. On average, workers climb the wage ladder faster when a job-to-job transition occurs via job postings compared to networks or the public agency.

Model

Model (I)

- Understand the impact of different recruitment channels on sorting.
- Equilibrium search model with two-sided heterogeneity with multiple search channels based on Cahuc et al. (2006).

Environment

- Continuous time, discount rate r, steady state.
- Workers types $x \in [0, 1]$, distribution measure $\lambda(x)$.
- Firm types $y \in [0, 1]$, distribution measure $\mu(y)$.
- Flow output of a job $F(x, y)$ with $F_x > 0$, $F_y > 0$.
- Wage negotiations where worker receives share β of surplus. Renegotiation whenever worker receives a credible outside offer.
- Flow income of unemployment $b(x)$.
- EU separation rate $\delta(x)$.

Model (II): Search Channels

Search and recruitment effort

- Workers and firms meet via one of three channels $c = p, n, a$ (job **p**ostings, personal **n**etworks, public **a**gency).
- Worker exogenous search effort $s_i^c(x)$ where $i = U, E$.
- Firm choose recruitment effort r^c at a cost $k_c(r)$.

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Matching functions

- Random matching $\rightarrow$ channel-specific matching function: $\theta^c = \bar{r}^c / \bar{s}^c$ determines meeting rates of
  - workers $f^c(\theta^c)$ (per unit of search effort),
  - firms $q^c(\theta^c) = f^c(\theta^c)/\theta^c$ (per unit of recruitment effort).

Competing hazards

- Firms and workers will use all the three channels to a certain degree (effort) and offers from these channels will arrive sequentially.

Value functions

- $S(x, y)$ joint value of a match, $U(x)$ value of unemployment
- Bellman equations

$$[r + \delta(x, y)]S(x, y) = F(x, y) + \delta(x, y)U(x) + \sum_c f^c(\theta^c)s_e^c(x)\beta \int_y^1 [S(x, y') - S(x, y)]\pi^c(y')dy'$$

$$rU(x) = b(x) + \sum_c f^c(\theta^c)s_u^c(x)\beta \int_{R(x)}^1 [S(x, y) - U(x)]\pi^c(y)dy$$

with meeting probabilities $\pi^c(y)$.

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with meeting probabilities $\pi^c(y)$.

- Reservation productivity $R(x)$

$$S(x,R(x)) \geq U(x) \quad , \quad R(x) \geq 0 \quad \text{(c.s.)}$$

Search and recruitment

Recruitment effort

- The first-order condition for recruitment effort in search channel c is

$$k^{c'}(r^c) = q^c(\theta^c)(1-\beta)\int_0^1 [\max[S(x,y) - U(x), 0]\psi^c(x,u) + \int_0^y [S(x,y) - S(x,\hat{y})]\psi^c(x,\hat{y})d\hat{y}]dx.$$

- The probability of a worker to match with a firm of type y via channel c (conditional on such a meeting taking place) is

$$\pi^c(y) = \frac{r^c(y)\mu(y)}{\bar{r}^c}$$

- Aggregate recruiting intensity in channel c defined by

$$\bar{r}^c = \int_0^1 r^c(y)\mu(y)dy$$

Search and recruitment

Search effort - Exogenous

- The probability that a firm meets a worker of type x from U or E employed in a firm of type y via channel c is

$$\psi^c(x,u) = \frac{s_u^c(x)u(x)}{\bar{s}^c} \quad , \quad \psi^c(x,y) = \frac{s_e^c(x)n(x,y)}{\bar{s}^c},$$

  where $u(x)$ and $n(x,y)$ are stationary measures of unemployed and employed workers, and with aggregate worker search intensity in channel c defined by

$$\bar{s}^c = \int_0^1 \left[s_u^c(x)u(x) + \int_0^1 s_e^c(x)n(x,y)dy \right] dx.$$

- Given aggregate effort on both sides of the labor market, tightness in channel c is

$$\theta^c = \frac{\bar{r}^c}{\bar{s}^c}.$$

Wages and Equilibrium

- The above worker and firm equations jointly determine recruiting intensities, matching probabilities and tightness, given value functions S and U and steady-state measures of unemployed and employed workers.
- Value of worker x in firm y with outside offer $\hat{y} \leq y$:

$$W(x, \hat{y}, y) = \beta S(x, y) + (1 - \beta) S(x, \hat{y}) \ .$$

- Value of worker x in firm y without outside offers:

$$W(x, u, y) = \beta S(x, y) + (1 - \beta) U(x) \ .$$

- Bargained wage $w(x, \hat{y}, y)$ consistent with Bellman equations.
- Employment distribution $n(x, \hat{y}, y)$ consistent with stock-flow identities.

▸ More

Quantitative Analysis

Calibration - SMM

Parametrization and targets:

- Monthly time period with $r = 0.00165$ to match a discounting factor of 5%.
- Heterogeneity $\rightarrow$ Beta distributions for x, (λ_0, λ_1), and y, with parameters (μ_0, μ_1).
- Since x and y are *unobserved*, we use a OLS wage regression to obtain uncorrelated worker and firm fixed effects:

$$\ln w_{it} = \alpha_i + \beta X_{it} + \varepsilon_{it} \ ,$$
$$\varepsilon_{it} = \gamma_{J(i,t)} + \eta_{it} \ .$$

- Targets: 10^{th}, 25^{th}, 50^{th}, 75^{th}, 90^{th} percentiles of the estimated fixed effect and wage distributions plus their standard deviations as well as a replacement rate of 0.65.
- These 19 moments also help us recover: β (bargaining power), b (unemp. income), the CES production function parameters

$$F(x, y) = F_0 \left(\alpha x^\rho + (1 - \alpha) y^\rho\right)^{1/\rho} .$$

Calibration -SMM

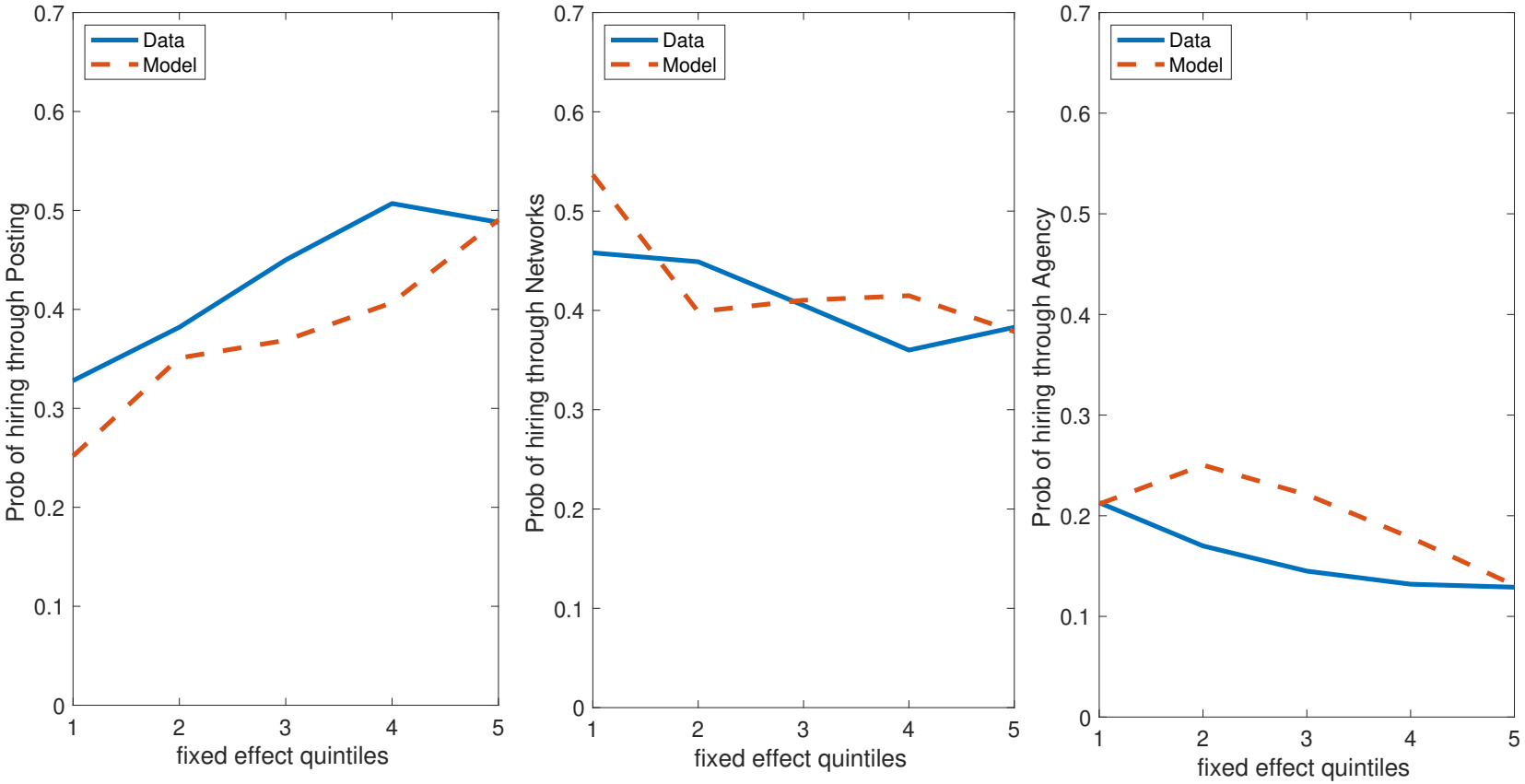
Parametrization and targets:

- The recruitment intensity cost function for channel $c = p, n, a$ is given by $c_0^c (r^c)^{\gamma^c}$, with parameters $c_0^c > 0$ and $\gamma^c > 1$.
- Workers' search intensity function is linear such that

$$s_i^c(x) = s_0^{c,i} + x(s_1^{c,i} - s_0^{c,i})$$

  with parameters $s_0^{c,i} \geq 0$, $s_1^{c,i} \geq 0$ and $c = p, n, a$ and $i = U, E$.
- To recover these parameters we use H^c, and EE^c and UE^c by firm and worker types.
- Cobb-Douglas matching function equal across search channels with efficiency parameter 0.1 and elasticity 0.5.
- Differences across channels are captured by the recruitment and search intensities.
- The separation rate is given by $\delta(x) = \delta_0 + (\delta_x - \delta_0)x$ and recovered by targeting EU by worker type.

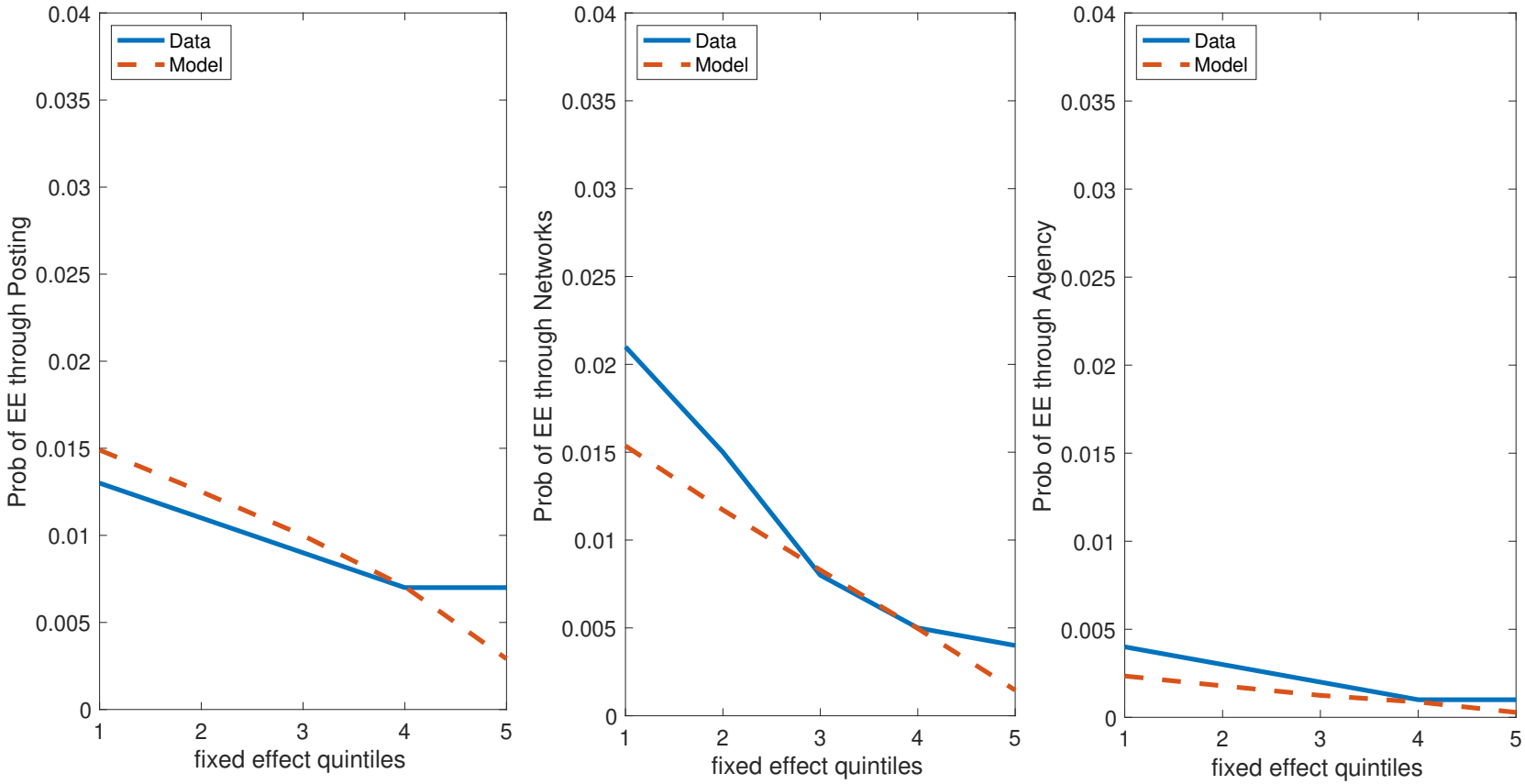
Successful channel by firm fixed effect quintile



Conditional on a hire, the probability this was through

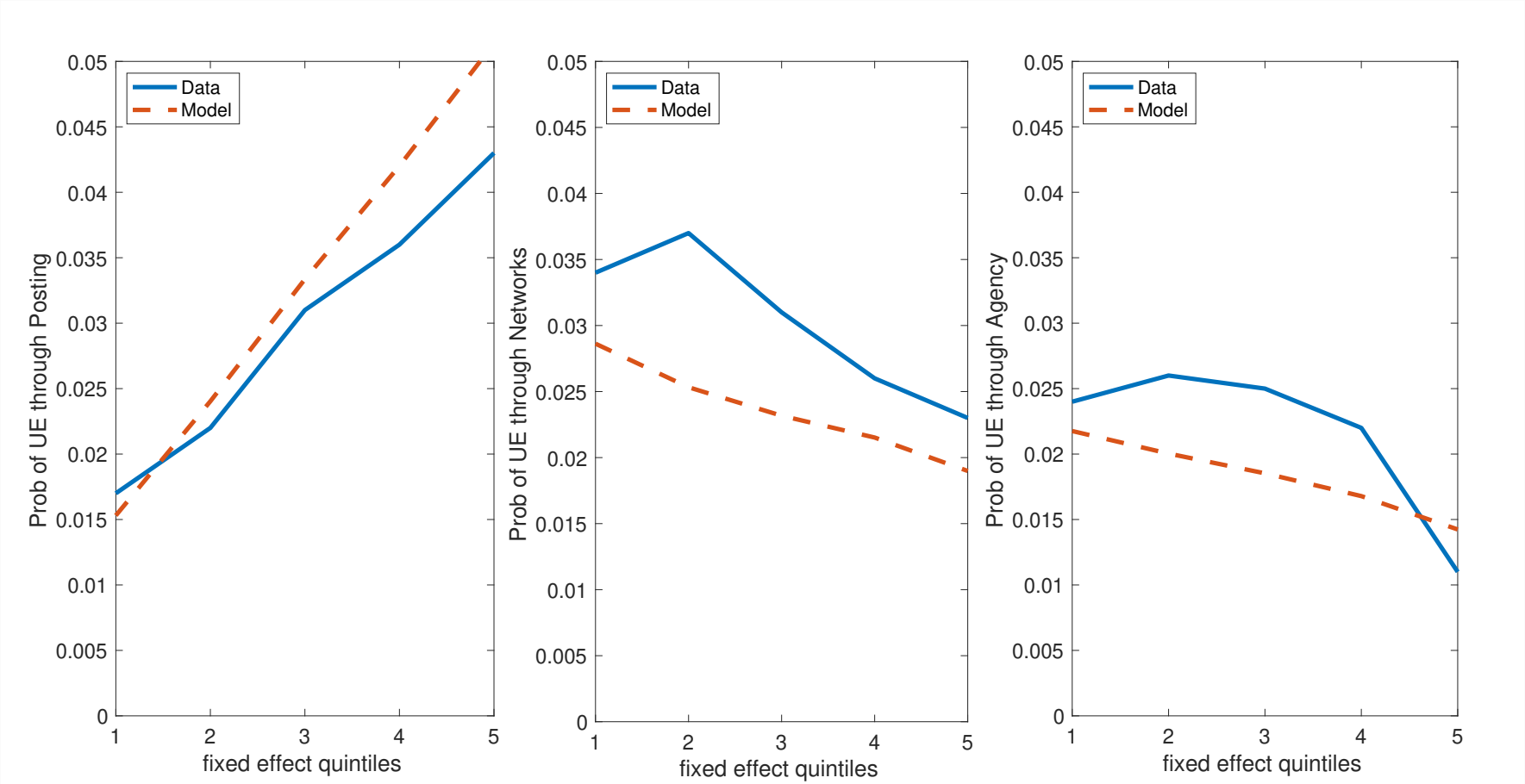
- posting $\rightarrow$ increases in firm wage quintile.
- networks $\rightarrow$ decreases in firm wage quintile.
- public employment agency $\rightarrow$ decreases in firm wage quintile.

EE rates by channel and worker fixed effect quintile



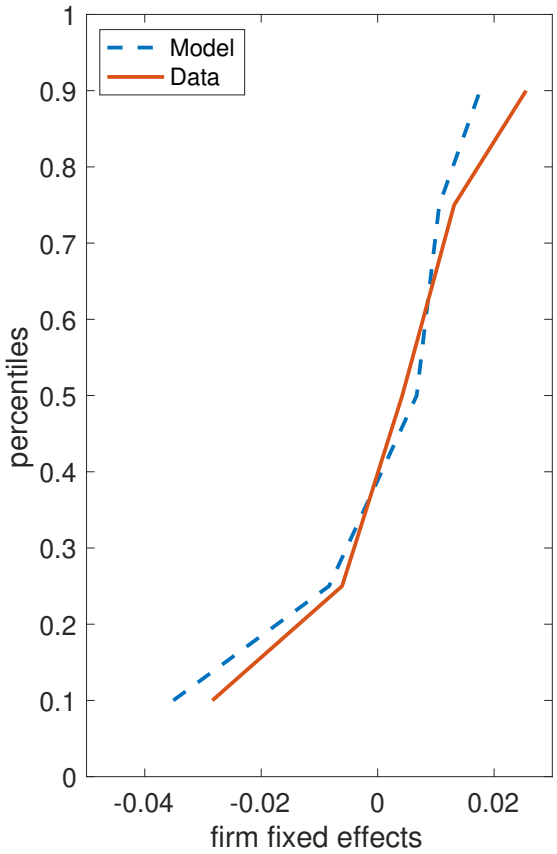
- *EE* transitions decrease in worker wage quintile.

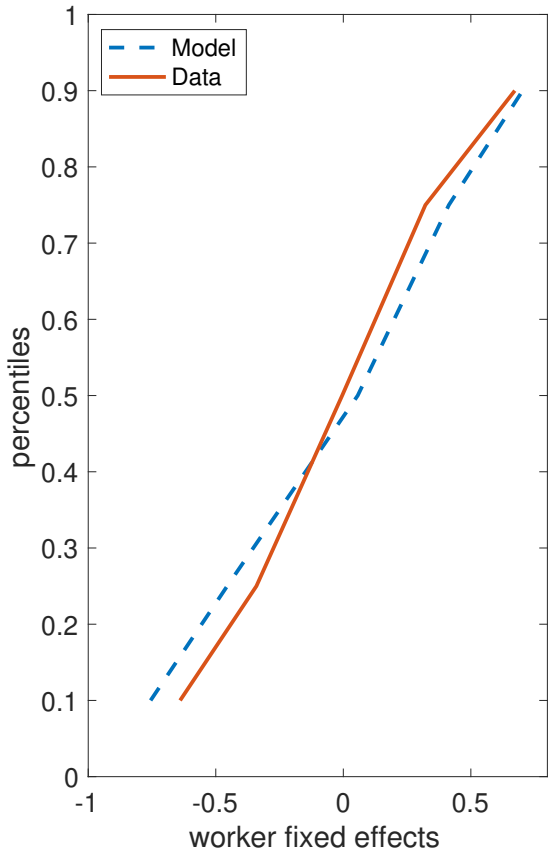
UE rates by channel and worker fixed effect quintile

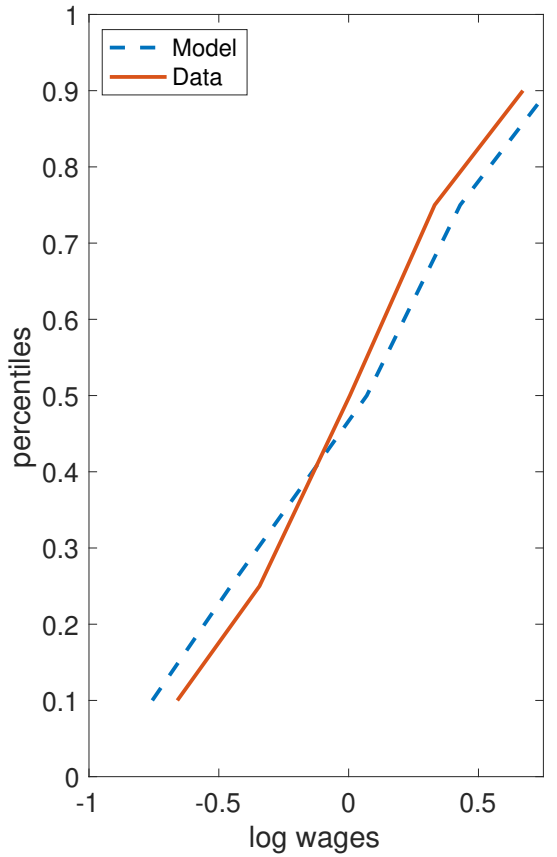


- *UE* transitions ONLY increase in worker wage quintile through posting.
- **Together *EE* and *UE* $\rightarrow$ the probability of being hired increases in worker wage quintile through posting, but decreases through networks or agency.**

Fixed effect and wage CDF



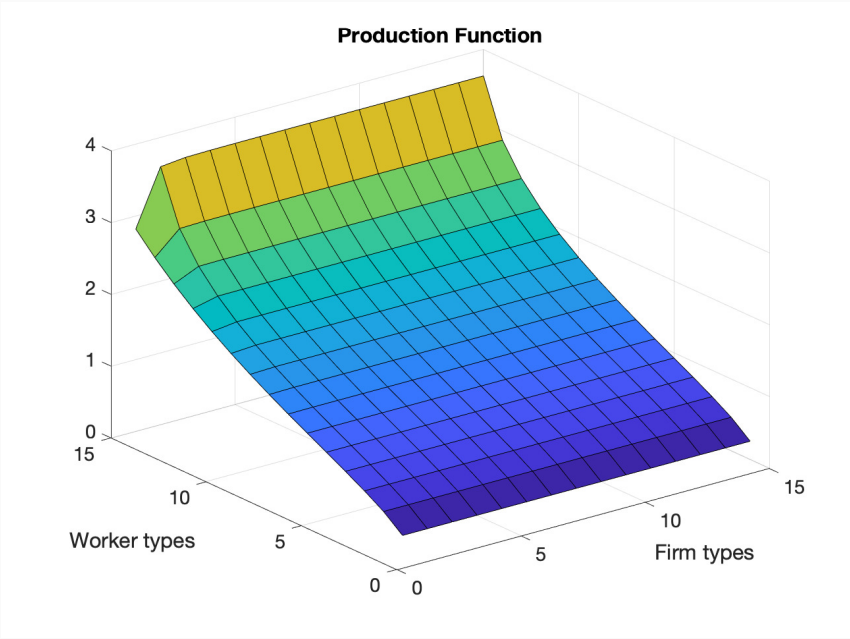


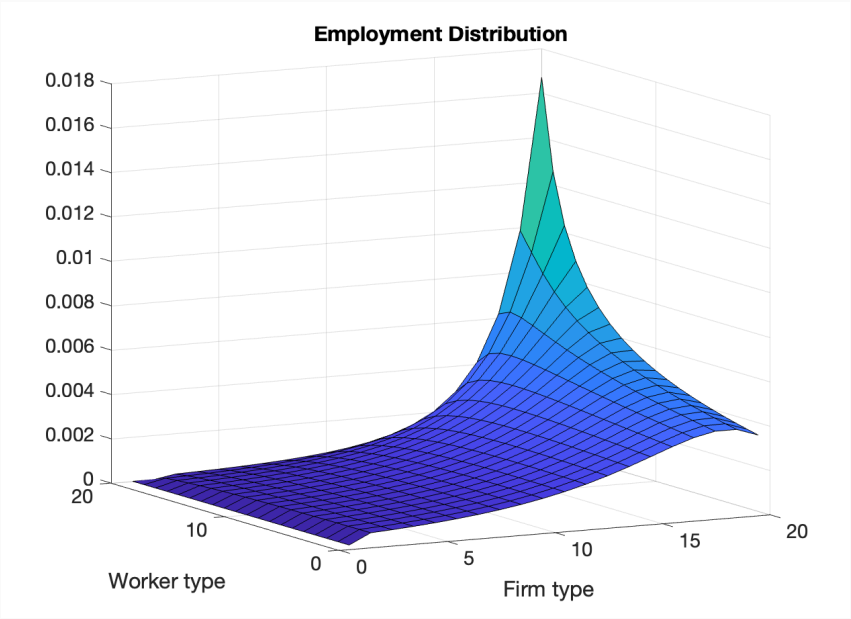


- The calibration matches the OLS firm and worker fixed effects and the wage distribution well.
- It also generates similar standard deviations, although a bit larger in the simulations.

Sorting Patterns

Production and employment





- The calibration implies a super-modular production function, with $F(x, y) = 9.75 \left(0.85x^{-4.7} + 0.15y^{-4.7}\right)^{-0.21}$
- It also implies positive sorting between workers and firm types, with a correlation coefficient of 13%.

Sorting by Search Channels (I)

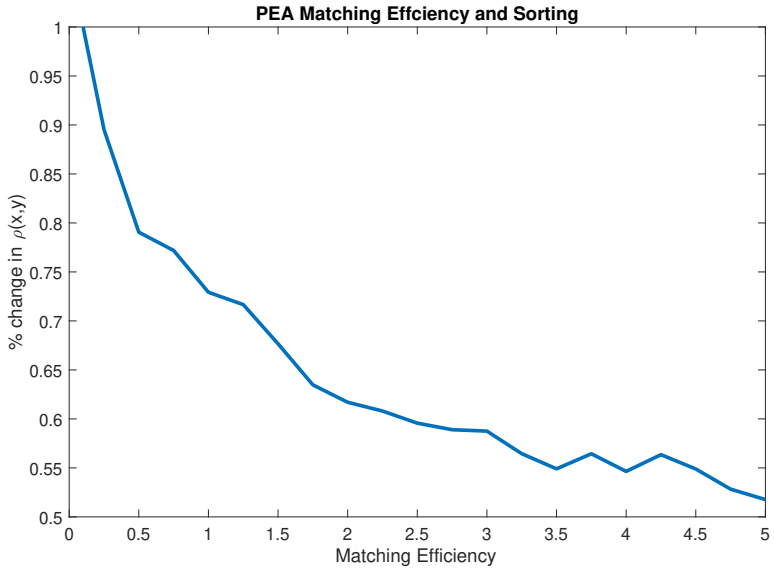
Suppose no **worker type** differential within a search channel?

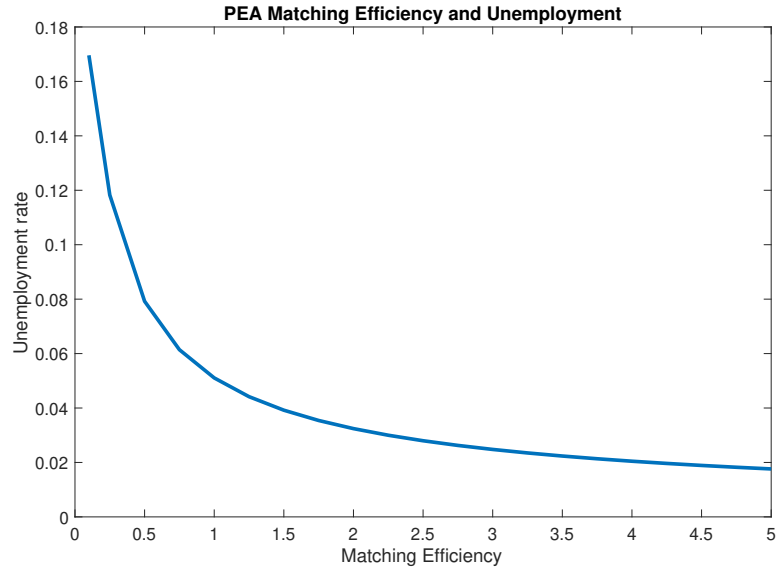
	Homogeneous Search of Workers		
%Δ	Posting	Networks	Public Agency
Sorting	-7.6%	**20.2%**	-2.3%

- Low type workers use more Networks → low type workers end up more often in higher type firms as these adjust their recruitment intensity.
- When workers use networks with the same intensity (cond. on emp status) → $\rho(x, y) \uparrow$ 20.2%.

Role of the Public Employment Agency

Increasing matching efficiency - Hartz III Reforms





- Increasing the matching efficiency of PEA leads to
  - All firms use more the PEA, especially high type firms.
  - Low type workers more prominent in unemployment.
  - $\Rightarrow$ reduction of sorting and unemployment.

Conclusions

Conclusions

- Firms' and workers' search activity and matching outcomes across search channels:
  - High-wage firms and workers match more frequently via postings.
  - Low-wage firms and workers match more frequently via networks and the public agency.
  - Postings (networks) help to hire employed and high-wage workers, especially for high-wage (low-wage) firms.
- Structural OTJS model with multiple search channels.
- Preliminary findings:
  - Strong impact of networks for labor market sorting.
  - Increasing the matching efficiency of the the PEA to reduce unemployment leads to a decrease in sorting.

Appendix

Search Behavior across Firms and Workers

Firms (JVS)

	No. applications	Selection rate	Recruitment hours	No. channels
AKM firm effect	9.509***	-0.085***	5.364***	-0.001
	(0.466)	(0.008)	(0.780)	(0.004)
No. Obs.	54,752	51,071	21,498	43,555
Adj. R^2	0.090	0.039	0.051	0.147

Controls: Job requirements, firm age (quad), 6 firm size categories, one-digit industry, and financial, demand and workforce constraints.

Workers (PASS)

	Active search	No. applications	Callback rate	Search hours	No. channels
AKM worker effect	-0.0347***	1.2020***	0.0192	0.2079***	-0.0168
	(0.0056)	(0.4205)	(0.0160)	(0.0713)	(0.0312)
No. Obs.	36,007	9,000	7,491	1,598	9,000
Adj. R^2	0.3024	0.0501	0.0045	0.1164	0.0709

Controls: Age (quad), gender, employment status, one-digit occupation.

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Search Channels and Poaching

	Prob. hiring emp. worker		
	Posting	Networks	Public agency
AKM firm effect	0.141***	0.222***	0.165***
	(0.012)	(0.013)	(0.011)
Successful search channel	0.119***	0.113***	-0.234***
	(0.004)	(0.004)	(0.004)
Successful channel × AKM firm effect	0.084***	-0.105***	-0.104***
	(0.021)	(0.020)	(0.030)
No. Obs.	66,755	66,755	66,755
Adj. R^2	0.047	0.046	0.056

Controls: Education requirements, firm age (quad), 6 firm size categories, one-digit industry, and financial, demand and workforce constraints.

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Search Channels and Type of Hired Worker (JVS-IEB)

	Hired AKM worker fixed effect		
	Posting	Networks	Public agency
AKM firm effect	0.146***	0.189***	0.162***
	(0.012)	(0.013)	(0.011)
Successful search channel	0.019***	0.013***	-0.048***
	(0.009)	(0.004)	(0.006)
Successful channel × AKM firm effect	0.039*	-0.071***	-0.062**
	(0.021)	(0.019)	(0.029)
No. Obs.	25,084	25,084	25,084
Adj. R^2	0.215	0.215	0.217

Controls: Education requirements, firm age (quad), 6 firm size categories, one-digit industry, and financial, demand and workforce constraints.

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Search Channels and Match Stability (JVS-IEB)

Probability of staying at the firm

	>12 **months**			>24 **months**		
	Posting	Networks	Public agency	Posting	Networks	Public agency
AKM firm effect	0.120***	0.155***	0.130***	0.171***	0.205***	0.190***
	(0.020)	(0.022)	(0.019)	(0.024)	(0.025)	(0.022)
AKM worker effect	0.066***	0.072***	0.072***	0.061***	0.069***	0.079***
	(0.013)	(0.012)	(0.011)	(0.015)	(0.014)	(0.013)
Successful search channel	0.009	0.019**	-0.062***	0.002	0.030***	-0.080***
	(0.007)	(0.007)	(0.010)	(0.009)	(0.009)	(0.012)
Search channel $\times$ AKM firm effect	0.055	-0.042	-0.003	0.077*	-0.028	-0.057
	(0.036)	(0.033)	(0.048)	(0.042)	(0.038)	(0.055)
Search channel $\times$ AKM worker effect	0.023	0.008	-0.003	0.042**	0.020	-0.064*
	(0.020)	(0.021)	(0.032)	(0.024)	(0.024)	(0.037)
Observations	19,152	19,152	19,152	16,097	16,097	16,097
Adj. R^2	0.035	0.035	0.037	0.040	0.040	0.042

Controls: Education requirements, firm age (quad), 6 firm size categories, one-digit industry, and financial, demand and workforce constraints.

- No evidence for *differential* impact of search channels on match stability.

Search Channels and Employment Stability

Probability of EU transition

	$<$ 12 **months**			$<$ 24 **months**		
	Posting	Networks	Public agency	Posting	Networks	Public agency
AKM firm effect	-0.030***	-0.047***	-0.029***	-0.055***	-0.057***	-0.052***
	(0.010)	(0.011)	(0.009)	(0.012)	(0.012)	(0.011)
AKM worker effect	-0.048***	-0.045***	-0.037***	-0.052***	-0.050***	-0.039***
	(0.006)	(0.006)	(0.005)	(0.007)	(0.007)	(0.006)
Successful search channel	-0.002	-0.020***	0.035***	-0.003	-0.017***	0.035***
	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.006)
Observations	19,152	19,152	19,152	16,097	16,097	16,097
Adj. R^2	0.025	0.027	0.029	0.030	0.031	0.033

Controls: Education requirements, firm age (quad), 6 firm size categories, one-digit industry, and financial, demand and workforce constraints.

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Search Channels across Firms

	Use of search channel			Successful channel		
	Postings	Networks	Public agency	Postings	Networks	Public agency
Poaching index	0.152***	-0.041***	-0.058***	0.098***	-0.042***	-0.049***
	(0.009)	(0.010)	(0.010)	(0.009)	(0.009)	(0.007)
Vocational degree	0.082***	-0.085***	0.034***	0.085***	-0.080***	0.010**
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.004)
Tertiary degree	0.178***	-0.112***	-0.034***	0.177***	-0.108***	-0.031***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.005)
No. Obs.	66,881	66,881	66,881	62,659	62,659	62,659
Adj. R^2	0.109	0.056	0.050	0.074	0.072	0.015

Controls: Education requirements, firm age (quad), 6 firm size categories, one-digit industry, and financial, demand and workforce constraints.

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Wages

Wage $w(x, \hat{y}, y)$ can be backed out from

$$[r + \delta(x, y)]W(x, \hat{y}, y) = w(x, \hat{y}, y) + \delta(x, y)U(x)$$

$$+ \sum_c f^c(\theta^c)s^c(x, e) \int_{\hat{y}}^1 [\max(W(x, y, y'), W(x, y', y)) - W(x, \hat{y}, y)]\pi^c(y')dy' \ .$$

Steady State

Stock-flow identities

$$n(x,y)\left[\delta(x,y)+\sum_c f^c(\theta^c)s^c(x,e)\int_y^1 \pi^c(y')dy'\right]=\sum_c f^c(\theta^c)\pi^c(y)\Big[u(x)s^c(x,u)\mathbb{I}_{y\geq R(x)} + \int_0^y n(x,\hat{y})s^c(x,e)d\hat{y}\Big] ,$$

$$u(x)=\lambda(x)-\int_0^1 n(x,y)dy ,$$

$$\hat{n}(x,\hat{y},y)\left[\delta(x,y)+\sum_c f^c(\theta^c)s^c(x,e)\int_{\hat{y}}^1 \pi^c(y')dy'\right]$$
$$=\sum_c f^c(\theta^c)s^c(x,e)\left\{n(x,\hat{y})\pi^c(y)+\left[\hat{n}(x,u,y)+\int_0^{\hat{y}}\hat{n}(x,\tilde{y},y)d\tilde{y}\right]\pi^c(\hat{y})\right\} .$$

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Sorting by Search Channels (III)

What happens if the use of search channels does not differ across **employed workers**?

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What happens if the use of search channels
does not differ across **employed workers**?

	Benchmark	Homogeneous Search of Employed Workers
		All Channels
$\rho(x, y)$	0.223	0.309

Sorting by Search Channels (III)

What happens if the use of search channels
does not differ across **employed workers**?

	Benchmark	Homogeneous Search of Employed Workers			
		All Channels	Posting	Networks	Public Agency
$\rho(x, y)$	0.223	0.309	0.248	**0.274**	0.240

- Higher use of networks by low-productivity **employed** workers mitigates sorting.

Sorting by Search Channels (IV)

What happens if the use of search channels does not differ across **non-employed workers**?

Sorting by Search Channels (IV)

What happens if the use of search channels
does not differ across **non-employed workers**?

	Benchmark	Homogeneous Search of Non-Employed Workers
		All Channels
$\rho(x, y)$	0.223	0.217

Sorting by Search Channels (IV)

What happens if the use of search channels
does not differ across **non-employed workers**?

	Benchmark	Homogeneous Search of Non-Employed Workers			
		All Channels	Posting	Networks	Public Agency
$\rho(x, y)$	0.223	0.217	0.209	0.221	0.229

- Segmentation of **non-employed** workers has little impact on sorting.

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